Feb. 24, 1970 J. M. VALDESPINO 3,497,064

AEROBIC WASTE SYSTEM WITH PNEUMATIC EJECTION AND CHLORINATION

Filed April 17, 1969 2 Sheets-Sheet 1

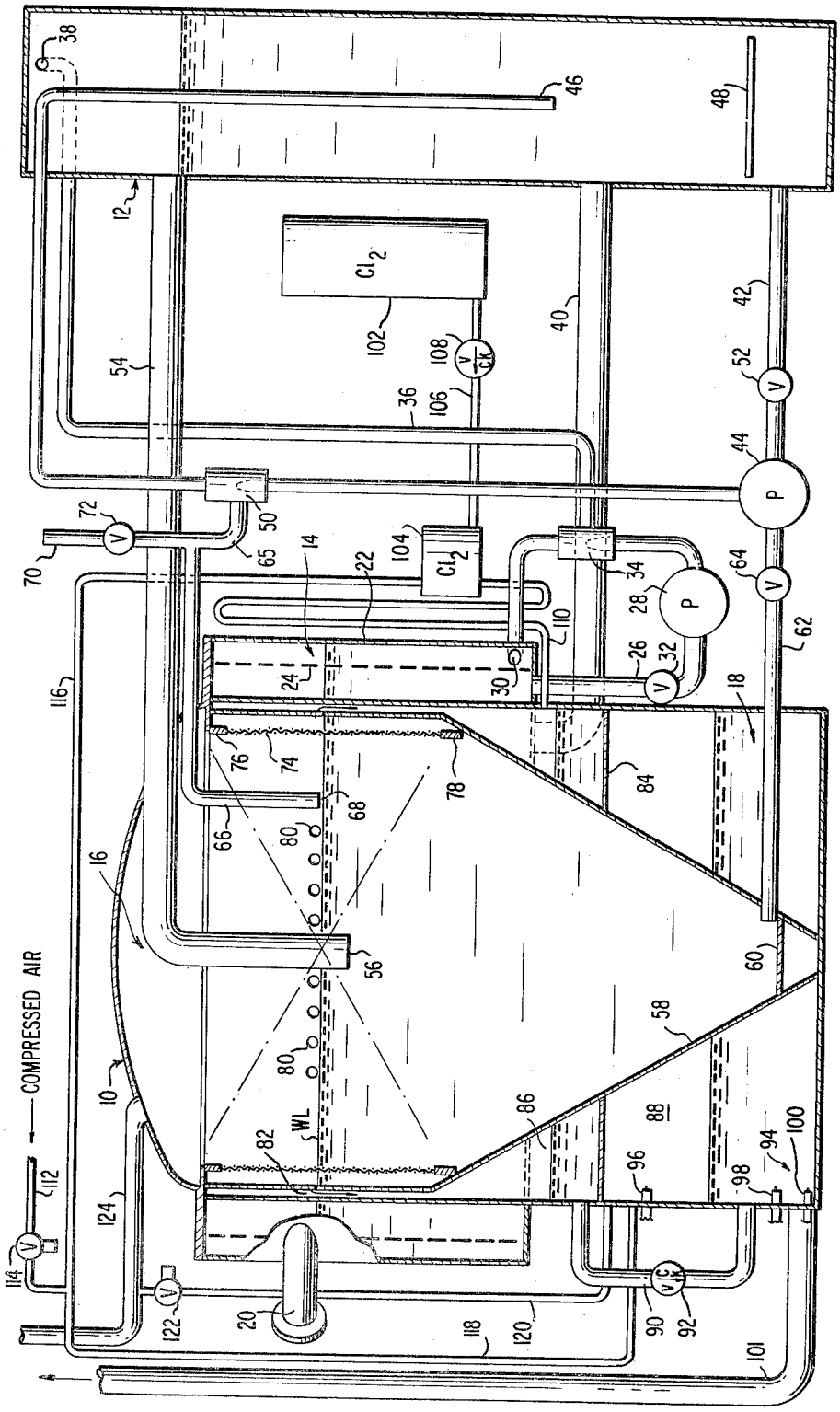


FIG. 1

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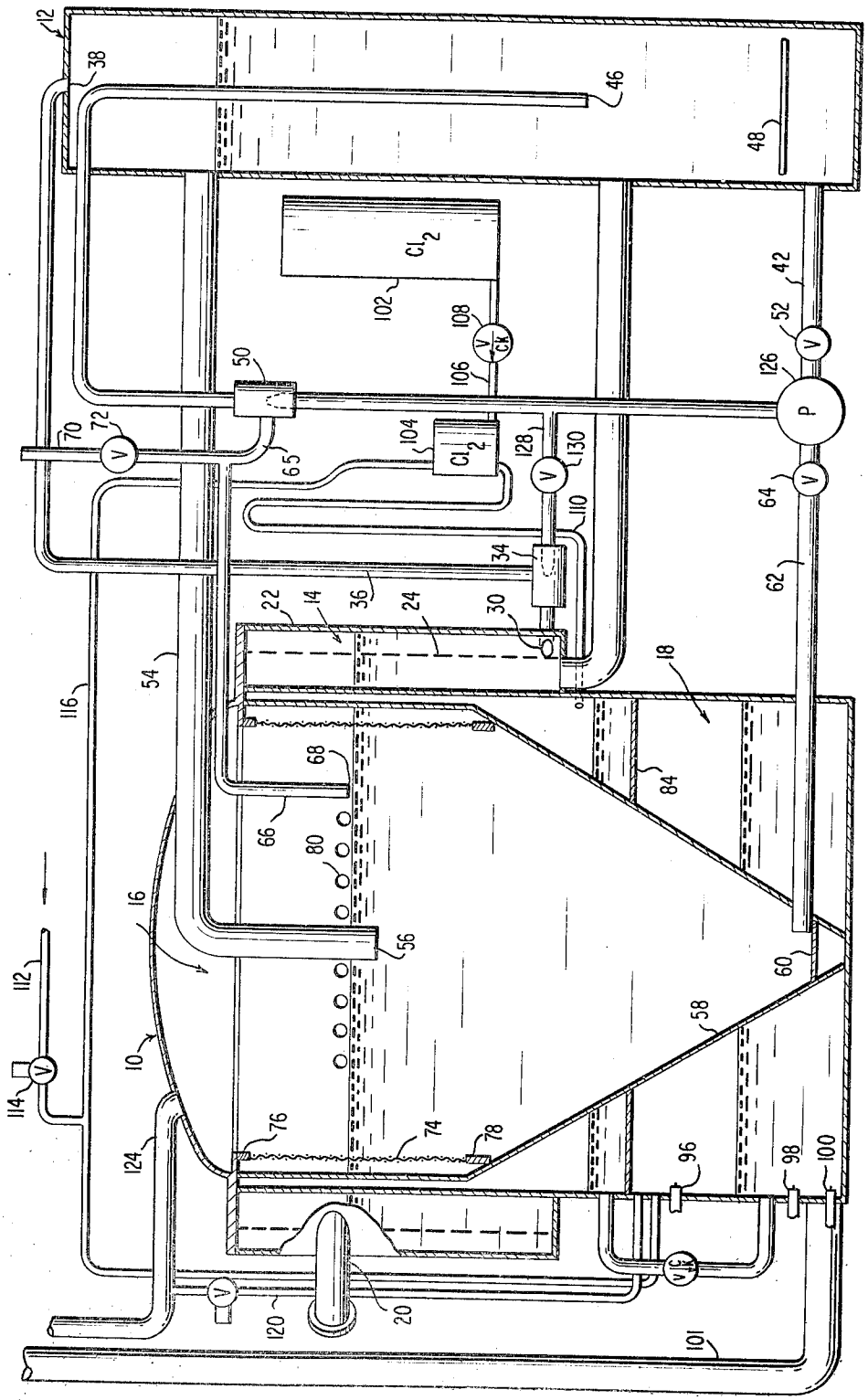


FIG. 2

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AEROBIC WASTE SYSTEM WITH PNEUMATIC EJECTION AND CHLORINATION

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U.S. Cl. 210—117 11 Claims

ABSTRACT OF THE DISCLOSURE

An aerobic waste treatment system of the type that introduces air through a venturi directly into a solid waste material, aerates in a vacuum tank, and preaerates in combination with hydraulic comminution; includes a pneumatic ejection and chlorine feed system to chlorinate waste material in measured batches and also forcibly eject the chlorinated waste material by pneumatic pressure without utilizing corrodable moving parts. A settling tank in the system is surrounded by the hydraulic comminutor and has a filtering screen to filter the outflow and a skimmer operated by venturi vacuum to skim the settling tank.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to improvements in aerobic waste treatment systems and particularly to chlorination and forcible discharge from such systems.

Prior art

It is known in the prior art to aerobically treat waste material following a hydraulic comminution and preaeration step, see U.S. Patent 3,311,239 granted Mar. 28, 1967. If the waste material is to be discharged by gravity, it merely flows over a weir in a settling tank. However, many such systems are useful on ships and are positioned below the water line so it is necessary to forcibly eject the effluent. In other places where the system would be useful it is also desirable to provide forcible ejection of the effluent. The use of pumps with moving parts for forcible ejection causes problems due to the corrosion of the pump parts and the requirement common to such systems of only part-time or batch discharge.

It is also desirable in waste treatment systems to chlorinate the effluent to kill the bacteria in it. The use of chlorine further complicates the corrosion problems mentioned above, and measuring the correct amount of chlorine to add is a further complication, especially when there is intermittent discharge.

For a ship board installation of a waste treatment system listing of the ship must be accommodated. Furthermore, floating grease should be skimmed from the top of the settling tank and floating solids prevented from passing from the settling tank into the discharged effluent.

SUMMARY OF THE INVENTION

An aerobic waste treatment system, e.g. of the type shown in U.S. Patent 3,311,239 granted Mar. 28, 1967, includes a pneumatic ejection batch discharge of the effluent and pneumatic feed of a measured amount of chlorination, both automatically operated in response to liquid level in an ejection tank. Other improvements in the art include a filter screen and skimmer in the settling tank and the use of a single pump for both preaeration-hydraulic comminution and vacuum aeration.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view, partially schematic, illustrating the system of this invention.

FIG. 2 is a view similar to FIG. 1 illustrating a modification utilizing a single pump.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the aerobic waste treatment system of this invention includes a primary tank assembly **10** and a vacuum aeration tank **12**. The primary tank assembly is composed of a preaeration-hydraulic comminution tank **14**, a settling tank **16**, and an ejection tank **18**.

An incoming conduit **20** is provided for feeding liquid and solid waste material into the preaeration-hydraulic comminution tank **14**. This tank has a cylindrical outer wall **22** and a cylindrical expanded metal grinding screen **24** spaced between the outer and inner wall. Hydraulic comminution and preaeration are accomplished by recirculating the incoming liquids and solids in a recirculating loop line **26**, the force for recirculation being provided by pump **28** and the recirculated liquids and solids re-entering the comminution tank through tangential inlet **30** which directs the liquids and solids against the outside of the cylindrical expanded metal grinding screen **24** to reduce the solid materials to fine solids in a manner similar to that described in Patent 3,311,239. The recirculating loop is controlled by valve **32** and the recirculated material is aerated with a preaeration venturi aspirator **34** which draws air in through air line **36** having its outer end **38** in the vacuum aeration tank **12** to draw the vacuum therein.

A conduit **40** connects the preaeration-hydraulic comminution tank **14** to the vacuum aeration tank **12** so that materials in tank **14** after a certain amount of comminution and preaeration may be discharged through line **40** into vacuum aeration tank **12**. Vacuum aeration tank **12** also has a recirculation loop or line **42** which includes a pump **44** and a return line **46** discharging the recirculated materials toward a baffle **48** near the bottom of the tank **12**. The recirculation line includes an aeration venturi aspirator **50** for accomplishing the aeration and valve **52** controls the recirculation loop.

Aeration tank **12** is under vacuum which is pulled by preaeration venturi aspirator **34** and this vaccum aids in the aeration of the materials in tank **12**. A line **54** extends from near the top of tank **12** into the settling tank **16** with an outlet **56** of conduit **54** being below a waterline WL in the settling tank so as to accommodate listing of the ship up to the maximum list angle as illustrated by the dot and dash lines in FIG. 1 by virtue of the outlet **56** being a sufficient distance below the water level at the center of the tank.

Settling tank **16** is part of the primary tank assembly and includes conical lower side walls **58** and a bottom wall **60** for accumulating the settled solids which have been aerated. A conduit **62** is provided for recirculation of the solids via pump **44** and under control of valve **64** through the venturi aspirator **50** and back into the vacuum aeration tank **12** through outlet **46**. The aeration of these solids gets the oxygen to the solid materials much better and more efficiently than aeration of liquids with solids therein.

An air line **65** providing the air drawn into venturi aspirator **50** has a branch **66** extending into the settling tank **12** with outlet **68** positioned just above the water level WL to function as a vacuum skimmer and to skim off the floating grease and solids from the settling tank and put them back through the system. The air line **65** includes a vent to atmopshere **70** controlled by a valve **72** which therefore also functions to control the skimming action.

Within the settling tank **16** there is positioned a fine filter screen **74** extending around the periphery of the tank above and below the water level and positioned inwardly of the side walls of the tank by supports **76** and **78**.

At the water line WL within the settling tank **16** there are a number of orifice outlets **80** which are behind the annular screen **74**. Therefore, the screen screens out any solid materials which might otherwise pass through the orifice outlets **80** into the ejection tank **18**.

Between the outer wall of the settling tank **16** and the inner wall of the hydraulic comminution preaeration tank **14** is an annular passageway **82** through which the discharged effluent may flow into the ejection tank **18**. The ejection tank **18** is divided into two compartments by a horizontal dividing plate **84**. An upper compartment **86** is a chlorine receiving compartment while a lower compartment **88** is an effluent discharge compartment. The compartments are in fluid communication via conduit **90** controlled by a one way valve **92** which permits flow only from the upper compartment **86** to the lower compartment **88**, and checks flow in the reverse direction.

The effluent discharge compartment **88** has a liquid level sensor system **94** including an upper level electrode **96**, a lower level electrode **98** and a common electrode **100** for the purpose of sensing the liquid level in the compartment **88** and controlling the chlorine feed and pneumatic ejection accordingly.

The system includes a chlorine solution tank **102** and a chlorine receiver receptacle **104** of measured volume to provide the correct amount of chlorine for a discharged batch volume of effluent. The chlorine solution tank and chlorine receiver receptacle are connected by tubing **106** which has a check valve **108** allowing flow only from the chlorine solution tank to the chlorine receiver receptacle. Another length of tubing **110** connects the chlorine receiver **104** to the chlorine receiving compartment **86** and includes an upper loop to prevent siphoning.

A compressed air inlet **112** receives compressed air from any suitable source such as a compressed air storage tank and feeds the compressed air into the system for controlling chlorination and pneumatic ejection under control of a normally closed solenoid valve **114**. The compressed air line branches after solenoid valve **114** into a chlorine feed air line **116** connected to the chlorine receiver receptacle **104** and a pneumatic ejection air line **118** connected directly into discharge compartment **88**. The discharge compartment **88** is also provided with a vent tubing connection **120** which is controlled by a normally open solenoid valve **122** to discharge into a vent stack **124** of the settling tank.

The operation of the system shown in FIG. 1 will now be described. A substantial portion of the operation especially in the preliminary stages of hydraulic comminution-preaeration, vacuum aeration, and settling is similar to that described in U.S. Patent 3,311,239. The incoming waste material, liquids and solids are discharged from line **20** into the hydraulic comminution-preaeration tank **14**. This waste material is comminuted and aerated by being recirculated through recirculation line **26** by means of pump **28** with aeration provided by venturi aspirator **34** and hydraulic comminution by the forcible discharge of the recirculated liquids and solids against the outer periphery of cylindrical grinding screen **24**.

The comminuted liquid and solids waste materials are discharged from tank **14** into vacuum aeration tank **12** by flow through line **40**. The liquids in tank **12** are aerated and the tank is held under vacuum due to the action of venturi aspirator **34**, the aeration being accomplished by recirculation through line **42** via pump **44** through venturi aspirator **50** and the recirculted solids are directed toward baffle **48**. Flow from the vacuum aeration tank into the settling tank is via line **54** with its outlet **56** being beneath the water level WL at the center of the tank to be sure that the discharge is always under the water level even when a ship lists. The solids settling in settling tank **60** will be aerated and recirculated via line **62**, pump **44** and venturi aspirator **50** into vacuum aeration tank **12**. Skimming of floating material from the settling tank is accomplished by skimming tube **66** having an outlet at the water level **68** and being operated by the venturi aspirator **50**. The liquid effluent from the settling tank is filtered by filtering screen **74** before passing through the orifices **80** into chlorine receiving compartment **86** of the ejection tank **18**.

During the pneumatic ejection cycle when normally closed solenoid valve **114** is opened, air under pressure passes through chlorine feed line **116** into the top of chlorine receiver receptacle **104** and forces chlorine out of this receptacle through line **110** into the chlorine receiver compartment **86**. The amount of chlorine fed will be equal to the amount of chlorine in receiver receptacle **104** plus a negligible amount of chlorine in the tubing. This amount of chlorine solution is pre-calculated to provide adequate chlorination for the volume discharged during batch ejection.

At the same time the normally closed solenoid valve **114** opens, compressed air passes through line **118** forcing the liquid in discharge tank **88** to seek a way to escape. Check valve **92** prevents the liquid from passing upwardly into compartment **86** so the liquid passes out through effluent discharge line **101**.

The chlorine feed and effluent discharge cycle is started when the liquid level in compartment **88** rises to the level of the top electrode **96**. This causes opening of normally closed solenoid **114** and closing of normally open vent solenoid **122**. The vent being closed, the compressed air ejecting the liquid causes the liquid to flow out discharge line **101** until the lower level liquid sensor **98** is uncovered at which time the position of the solenoid valves **114** and **122** return to their normal position, the solenoid vent valve **122** being normally open and the compressed air solenoid valves **114** being normally closed so that the system can again start filling the discharge compartment **88** as required.

FIG. 2 shows another embodiment of the invention wherein many of the components are identical with that of FIG. 1 and like reference numbers have been applied where the components are identical. FIG. 2 differs from FIG. 1 in that only a single pump **126** is used for the recirculation hydraulic comminution preaeration and for the vacuum aeration skimming. As shown in FIG. 2 pump **126** discharges into venturi aspirator **50** and through a branch line **128** controlled by valve **130** into the preaeration venturi **34**. The recirculation for hydraulic comminution is not directly out of the preaeration tank **40** but is thus out of the vacuum aeration and settling tanks. The operation of the system of FIG. 2 is identical to that of FIG. 1 with the exception that the single pump **126** pumps the liquids through both venturi aspirators **34** and **50**.

As can be seen, a unique system for batch chlorination and effluent ejection utilizing pneumatic force automatically controlled solves many problems of corrosion, ejection and chlorination in a small and compact waste treatment system.

I claim:

1. An aerobic waste treatment system of the type including an aeration tank for aerating waste material, a settling tank in communication with the aeration tank for settling aerated waste material, force discharge means for discharging effluent, and chlorination means for chlorinating the discharged effluent, the improvements comprising: an injection tank connected to receive liquid effluent discharge from the settling tank, liquid level sensing means in the ejection tank, a receiver receptacle tank of predetermined volume connected to selectively receive a chlorine solution from a chlorine solution tank and to selectively discharge the predetermined volume of chlorine solution into the ejection tank, a source of gas under pressure controllably connected to the chlorine receptacle and to the ejection tank to cause discharge of chlorine from the chlorine receptacle into the ejection

tank and to cause discharge of chlorine effluent from the ejection tank under control of the liquid level sensing means.

2. An aerobic waste treatment system as in claim 1 wherein the ejection tank is divided into two compartments, a chlorine receiving compartment and an effluent discharge compartment, the chlorine receiver receptacle discharges into the chlorine receiving compartment, and the source of gas under pressure is in communication with the effluent discharge compartment and the chlorine receiver receptacle.

3. An aerobic waste treatment system as in claim 2 wherein the compartments of the ejection tank are in communication through a one way check value allowing flow from the chlorine receiving compartment to the effluent discharge compartment.

4. An aerobic waste treatment system as in claim 3 wherein the effluent discharge compartment discharges into an upwardly extending discharge pipe, and further comprising means under control of liquid level sensors for venting the effluent discharge compartment.

5. An aerobic waste treatment system as in claim 4 wherein the settling tank discharges into the chlorine receiving compartment of the ejection tank through a filtering screen in the settling tank.

6. An aerobic waste treatment system as in claim 5 wherein the chlorine receiving compartment of the ejection tank surrounds a portion of the settling tank, and the settling tank is in communication with the chlorine receiving compartment of the ejection tank through a series of orifices in the wall of the settling tank behind the filtering screen.

7. An aerobic waste treatment system as in claim 6 wherein the aeration tank is in communication with the settling tank via a conduit which extends vertically into the settling tank at the center thereof and to a point below the liquid level to transfer aerated liquids and solids from the aeration tank to the settling tank and prevent uncovering of the end of the conduit on listing of a ship mounting the system.

8. An aerobic waste treatment system of the type including a preaeration hydraulic comminuting tank for receiving incoming waste material, a first venturi aspirator for preaeration of recirculated liquids from the preaeration-hydraulic comminution tank, a vacuum aeration tank

connected to receive preaerated comminuted waste material, a second venturi aspirator for aeration of recirculated waste materials outside the vacuum aeration tank, a settling tank connected to receive vacuum aerated waste materials from the vacuum aeration tank, a connection for recirculating solids from the bottom of the settling tank through the venturi aspirator outside the vacuum aeration tank, a conduit connecting an air aspirating connection of the first venturi aspirator to the vacuum aeration tank to draw a vacuum therein, with the improvement comprising: a single pump connected to recirculate liquids through both venturi aspirators for venturi preaeration of the recirculated waste material fed into the hydraulic comminutor, for aeration of recirculated waste material externally of the vacuum aeration tank, and for aeration of recirculated solids from the bottom of the settling tank.

9. An aerobic waste treatment system as in claim 8 wherein the second venturi aspirator has an air aspirating connection to a surface skimmer of the settling tank.

10. An aerobic waste treatment system as in claim 9 wherein the preaeration-hydraulic comminuting tank is an annular tank mounted around the periphery of the settling tank.

11. An aerobic waste treatment system as in claim 8 further comprising: automatic pneumatic ejection and chlorination means including a chlorine solution receiver tank, a source of compressed air, and liquid level sensors to control the compressed air and in turn provide selective batch discharge of the chlorine solution receiver tank to chlorinate effluent from the settling tank and of the effluent from the settling tank.

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JAMES L. DECESARE, Primary Examiner

U.S. Cl. X.R.

210—120, 152, 195, 220, 256